EXCERPTS FROM THE DEPARTMENT RECORD

3. NOISE:

a. Information submitted by Evergreen Wind Power III, LLC and their consultants (Stantec and RSE).

EVERGREEN WIND POWER III, LLC
ROLLINS WIND PROJECT
PENOBSCOT COUNTY, MAINE

SOUND LEVEL ASSESSMENT

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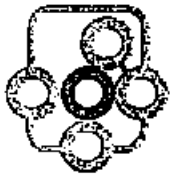

Resource Systems Engineering

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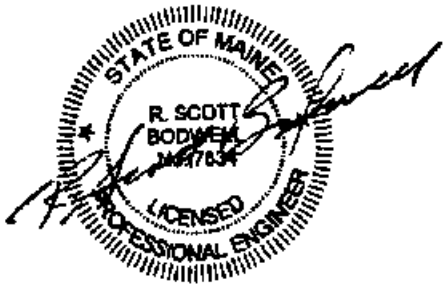


DISCLAIMER

This document has been prepared in accordance with generally accepted engineering practices associated with environmental acoustics. No other warranty, expressed or implied, is made.

EVERGREEN WIND POWER III, LLC
ROLLINS WIND PROJECT
PENOBSCOT COUNTY, MAINE
SOUND LEVEL ASSESSMENT

CONTENTS

LIST OF ACRONYMS

ANSI	American National Standards Institute
dB	Decibel (Unit of Sound Pressure Level)
dBA	Decibel A-weighted
DEP	Department of Environmental Protection
Hz	Hertz (cycles per second)
ISO	International Organization for Standardization
kVA	KiloVolt-Ampere
L_{A1}	Sound Level Exceeded 1% of a Measurement Period (dBA)
L_{A10}	Sound Level Exceeded 10% of a Measurement Period (dBA)
L_{A50}	Sound Level Exceeded 50% of a Measurement Period (dBA)
L_{A90}	Sound Level Exceeded 90% of a Measurement Period (dBA)
L_{Aeq}	Equivalent Sound Level
$L_{Aeq\text{-}Hr}$	Hourly Equivalent Sound Level
L_w	Sound Power Level
mph	Miles per hour
MRSA	Maine Revised Statutes Annotated
RSE	Resource Systems Engineering

EVERGREEN WIND POWER III, LLC
ROLLINS WIND PROJECT
PENOBSCOT COUNTY, MAINE

SOUND LEVEL ASSESSMENT

1.0 INTRODUCTION

Resource Systems Engineering (RSE) completed an analysis of sound levels for the Rollins Wind Project, a proposed 60 megawatt (MW) wind energy facility to be located in the Lincoln area of Penobscot County, Maine. The objective of the sound assessment was to determine the expected sound levels from routine operation of the wind project and compare them with relevant environmental noise standards.

Sound levels generated during construction and operation of many types of facilities can be regulated by federal, state, and local noise standards. The Maine Department of Environmental Protection (DEP) regulates noise under authority of the Site Location of Development Law (38 M.R.S.A 481-490). The current Maine DEP noise regulation, Chapter 375.10, Control of Noise, was established in November 1989 to protect certain existing land uses, such as residential properties, schools, and recreation areas, from excessive noise levels generated by new or expanded developments.

The following report provides a description of the wind project, identifies land uses in the project vicinity, presents a summary of Maine DEP noise standards, and sound level estimates for future wind turbine operations. The Sound Level Assessment provides a comprehensive evaluation of sound levels from construction and operation of the wind turbines. Sound levels from construction activity, and operation of the substation and other electric transmission facilities are briefly discussed. The sound level estimates are compared to Maine DEP sound level limits to demonstrate that the Rollins Wind Project will meet applicable sound level limits.

2.0 SOUND AND DECIBELS

Sound is a rapid fluctuation in pressure that the human ear has the potential to detect. The decibel or dB is the unit of measurement for sound. The decibel scale is logarithmic to avoid large unmanageable numbers normally associated with pressure change. Figure 1 shows a comparison of sound pressure and decibel levels for some typical sound environments.

Sound level performance specifications often provide the sound power level emitted by a particular noise source such as a transformer. Similar to sound pressure level, the sound power level or L_w is a logarithmic measure of sound expressed in decibels compared to a specified reference level. The difference is that the reference level for sound power is 10^{-12} watts compared to the reference level for sound pressure which is in units of micropascals.

Undesirable sound is generally referred to as *noise*. The effects of noise depend both on its frequency (or pitch), decibel level, and duration, particularly in relationship to changes in existing sound levels. The frequency of a sound generally refers to the number of vibrations per second, measured in hertz (Hz). The frequencies of sounds audible to humans range from about 20 Hz to 20,000 Hz, with greater sensitivity to frequencies above 1,000 Hz.

Sound may consist of a single frequency known as a pure tone, but is generally a disorderly mixture of many frequencies. When measuring sound, the A-weighted sound levels are typically used in order to simulate the hearing response of the human ear to varying sound level frequencies. A-weighted sound levels are expressed as dBA.

Sound propagation in air can be compared to ripples on the surface of a pond. The ripples spread out uniformly in all directions of the pond surface decreasing in amplitude as they move further from the source. For every doubling of distance from a stationary hemispherical point source, the sound level drops by 6 dB. Thus if the sound level is 50 dBA at 500 feet, the sound level at 1000 feet will be 44 dBA, and will be 38 dBA at 2000 feet. With an obstacle in the sound path, such as intervening terrain or a building, part of the sound is reflected, part is absorbed and the remainder is transmitted through or around the object. The amount of sound that is reflected, absorbed or transmitted depends on the properties of the object, its size, and the frequency (Hz) of the sound. Properties of an object and its effect on sound propagation are primary considerations in the design of noise control measures.

For constant sounds, a brief measurement close to the source can generally quantify the level of sound over both long and short periods. However, when sound sources vary, longer sampling periods are needed to accurately quantify the sound levels. Integrating sound level meters are commonly used to measure fluctuating sound sources. These meters record the sound level every 1/8 of a second when set to fast response and every one-second on slow response. When set to fast, the instrument measures 480 sound levels every minute and over 28,000 records in an hour. Due to the large number of readings, statistical parameters are used for analysis and comparison of measurement data.

The most commonly used parameter is the equivalent sound level or L_{Aeq}. The L_{Aeq} is used to represent the sound energy during a given sampling period as a constant decibel level. The L_{Aeq} takes all sound level fluctuations into account similar to an averaging technique; however, this is accomplished mathematically to deal with decibels as logarithmic expressions. At a site influenced by variable sounds such as vehicle or aircraft traffic, the L_{Aeq} distributes the traffic sound energy over the entire measurement period to calculate a single decibel level. Short periods of elevated sound levels can significantly increase L_{Aeq} over a measurement period. For example, if the sound level over an hour was 30 dBA except for five minutes when traffic noise measured 60 dBA, the L_{Aeq} for the hour would be 49 dBA.

Other common statistical parameters include L_{A10}, L_{A50} and L_{A90}, which represent the sound level exceeded 10%, 50%, and 90% of the time during the measurement, respectively. The L_{A90} excludes most transient or intermittent noise sources and therefore, is commonly used to determine the value of constant or *background* sound during a measurement. LA50 is the median sound level and can be used to quantify nearly steady operations by removing the contribution of occasional, louder sound events such as wind gusts or traffic.

In order to calculate sound levels resulting from multiple sources, such as wind turbines, it is necessary to combine decibel levels from each source. Decibel levels must be added mathematically to reflect the logarithmic nature of the decibel unit. When two sounds of the same decibel level are combined, the resulting combined sound level is just 3 dB higher than the individual sound levels (e.g. 50 dB + 50 dB = 53 dB). The analysis contained in this report addresses both individual and combined sound sources associated with the proposed wind project.

3.0 SITE DESCRIPTION

The Rollins Wind Project is a 60-megawatt (MW) wind project with approximately 8 miles of associated 115-kilovolt (kV) transmission line to be located in Penobscot County, east and south of Lincoln. A site location map is presented as Figure 2.

The turbine portion of the project consists of 40 General Electric 1.5 megawatt (MW) turbines located in two clusters, Rollins North and Rollins South. Each turbine is 262 feet from the base to the center of the rotor hub, and a total of 389 feet to the tip of a fully extended rotor blade. The project involves permitting 41 potential turbine locations to allow flexibility in final location; only 40 turbines will be constructed. Turbines will be located in the towns of Winn, Lee, Lincoln, and Burlington. The South cluster, located in Lincoln and Burlington, will include 22 of the 23 turbines shown and connect to the northern portion of the project by a 34.5-kV connector line. The North cluster of 18 turbines will be located east of Lincoln center in the towns of Lincoln, Lee and Winn. Power from the 40 turbines will be collected in an overhead 34.5-kV collector line, delivered to the on-site substation, and converted to 115 kV for transmission to a connection point on Line 56 near Mattawamkeag. The substation will be located near the north end of the project (see Figure 2). Relative to applicable sound level limits, operation of the substation and transmission line is not expected to generate significant sound levels. Consequently, sound level estimates for the wind project do not include these facilities.

The majority of the proposed turbine areas are presently used for commercial forestry operations and contain developed logging roads that will be upgraded and used, where appropriate, to minimize clearing and wetland impacts. The turbines will generally run north–south along various ridges with base elevations of the turbines ranging from approximately 700 to 1,260 feet above mean sea level. In addition to the turbine structures, the project will include construction of an operations and maintenance facility at the south end and a substation near the north end of Rollins North.

For the proposed GE wind turbines, spacing between turbines within the two turbine clusters (North and South) will range from a minimum of approximately 720 feet to over 4,000 feet. There are no external ladders or similar structures proposed on the towers and no guy wires or external cables. Access for maintenance will be provided by ladders located inside the towers.

Based on aerial photography, field surveys and local tax records, uses in the vicinity of the project consist of undeveloped/forestry land in areas surrounding the turbine sites and rural residential properties mostly over 3,000 feet from the proposed wind turbines. The majority of residential properties in the vicinity of the project are located in the Town of Lincoln between the North and South turbine clusters. With the exception of a few seasonal residences (camps) within the general area of Rollins South, the residential properties between Rollins North and South are the nearest to the proposed wind turbines. Additional residential parcels are located in Lee approximately one mile east of Rollins North and in Burlington approximately 4,000 feet east of Rollins South.

Evergreen Wind Power III (Evergreen III) has purchased property or obtained leases with local landowners to install and operate wind turbines at the proposed locations. Evergreen III has also obtained agreements with landowners who may experience sound levels from the project that have the potential to exceed applicable sound level limits. As set forth by Maine DEP 375.10, Section C.5.s, a noise easement exempts the project from Maine DEP noise limits and remains in effect for the specific noise, parcel of land and term covered by the agreement. A Vicinity Site Plan showing the proposed wind turbine layout and substation location in relation to surrounding land uses and residences is shown as Figure 3. Parcels for which Evergreen III has a lease, easement or other agreement are indicated in Figure 3.

4.0 NOISE CONTROL STANDARDS

Relevant noise standards consist of regulations established by the Maine DEP. Maine DEP Regulation Chapter 375.10, *Control of Noise*, established in November 1989, applies hourly sound level limits at facility property boundaries and at nearby *protected locations*. Protected locations are defined as "any location accessible by foot, on a parcel of land containing a residence or approved subdivision...." In addition to residential parcels, protected locations also include but are not limited to schools, state parks, and designated wilderness areas (ref. Maine DEP 375.10.G.16).

The hourly equivalent sound level ($L_{Aeq\text{-}Hr}$) resulting from routine operation of the wind project is limited to 75 dBA at any facility property boundary. The limits at protected locations vary depending on local zoning or surrounding land uses and existing (pre-development) ambient sound levels.

At protected locations within commercially or industrially zoned areas, or where the predominant surrounding land use is non-residential, the hourly sound level limits for routine operation are 70 dBA daytime (7:00 a.m. to 7:00 p.m.) and 60 dBA nighttime (7:00 p.m. to 7:00 a.m.). At protected locations within residentially zoned areas or where the predominant surrounding land use is residential, the hourly sound level limits for routine operation are 60 dBA daytime and 50 dBA nighttime. In addition, where the daytime pre-development ambient hourly sound level at a protected location is equal to or less than 45 dBA and/or the nighttime hourly sound level is equal to or less than 35 dBA, the hourly sound level limits for routine operation are 55 dBA daytime and 45 dBA nighttime. For areas where pre-development ambient sound levels exceed the specified limits at a protected location, limits may be chosen as 5 dBA less than the pre-development sound levels (ref. Maine DEP 375.10.C.1).

In all cases, nighttime limits at a protected location apply up to 500 feet from sleeping quarters. At distances over 500 feet or where no sleeping quarters exist, daytime limits apply during all facility operating hours (ref. Maine DEP 375.10.G.16). Where various limits apply depending on the distance from sleeping quarters, all limits must be met at the protected location.

The Maine DEP regulation establishes sound level limits for construction, maintenance, and tonal and short duration repetitive sounds as follows:

> *Construction* - Sound from nighttime construction is subject to the same nighttime limits as routine operation. Even though daytime construction limits are contained in Maine DEP Chapter 375.10, normal daytime construction sound levels are exempt from this regulation by Maine Statute (38 M.R.S.A. Section 484). Equipment used in construction must also comply with applicable federal noise regulations and must include environmental noise control devices in proper working condition as originally provided by its manufacturer (ref. Maine DEP 375.10.C.2).
>
> *Maintenance* -- Sound from routine, ongoing maintenance activities are considered part of routine operations and subject to the daytime and nighttime limits for routine operation. Sound from occasional, major overhaul activities is regulated as construction activity (ref. Maine DEP 375.10.C.3).
>
> *Short Duration Repetitive and Tonal Sounds* - When routine operations produce a short duration repetitive or tonal sound, 5 dBA is added to the observed sound levels of these sounds for determining compliance. There is also a maximum sound level (L_{Amax}) limit for certain types of short duration repetitive sounds (ref. Maine DEP 375.10.C.1.d and e).

Sounds associated with certain activities are exempt from regulation under Maine DEP Chapter 375.10. Exempt activities associated with the proposed wind project may include (ref. Maine DEP 375.10.C.5):

- Construction activity during daylight or daytime hours, whichever is longer;

- Emergency maintenance and repairs.

An exemption also applies at protected locations where the landowner has conveyed a noise easement to the project that allows the project to potentially exceed the Maine DEP sound level limits.

When a development is located in a municipality that has duly enacted a quantifiable noise standard that (1) contains limits that are not higher than the Maine DEP limits by more than 5 dBA, and (2) limits or addresses the types of sounds regulated by the Maine DEP, then the Maine DEP is to apply the local standard rather than the Maine DEP standard. Further, when noise produced by a facility is received in another municipality, the quantifiable noise standards of the other municipality must be taken into consideration (ref. Maine DEP 375.10.B.1).

Inquiries to town offices and review of land use ordinances for Burlington, Lee, Lincoln and Winn indicate that no quantitative noise standards have been enacted in any of these municipalities.

5.0 EXISTING SOUND LEVELS

Measurements of the pre-development ambient sound levels are required only when the developer elects to establish that the daytime and nighttime ambient hourly sound level at representative protected locations exceed 45 dBA and 35 dBA, respectively (ref. Maine DEP 375.10.H.3.1). Without such ambient measurements, the Maine DEP quiet limits of 55 dBA daytime and 45 dBA nighttime apply at nearby protected locations. In recognition of the rural nature of the site and to be conservative, Evergreen III has elected to apply quiet limits at nearby protected locations even though pre-development ambient sound levels under weather conditions suitable for wind turbine operation can exceed the quiet area thresholds of 45 dBA daytime and 35 dBA nighttime.

6.0 SOUND LEVEL LIMITS

Maine DEP sound level limits at protected locations and property lines have been determined for the Rollins Wind Project based on landowner agreements and land uses. Evergreen III has obtained leases or agreements with many local landowners that exempt the project from sound level limits under the Maine DEP noise regulation. As set forth in Maine DEP Chapter 375.10, these sound level limits apply to routine operation of the proposed wind project and substation.

The most restrictive Maine DEP sound level limit of 45 dBA applies during nighttime hours at locations on residential parcels that are within 500 feet of a residence. The quiet daytime limit of 55 dBA applies during daytime hours (7 am to 7 pm) and during all hours at locations on residential parcels that are over 500 from a residence. Maine DEP sound level limits do not apply at protected locations where landowners have signed agreements with Evergreen III authorizing sound from the project that would exceed otherwise applicable Maine DEP sound level limits. Table 1 presents a list of receiver points in the vicinity of the wind project where the most restrictive sound level limits apply. These receiver points are also shown on Figure 3.

Table 1

Maine DEP Hourly Sound Level Limits (dBA)

Receiver Point[A]	Description	Distance From Nearest Wind Turbine (ft)	Maine DEP Hourly Limit (dBA) Daytime	Nighttime	Limit Basis
R1	East of Rollins North and 500 feet from dwelling	4,660	55	45	Quiet limits at protected location
R2	Southeast of Rollins North at residential lot line	2,025	55	45	Quiet limits at protected location
R3	Southwest of Rollins North and 500 feet from dwelling	2,140	55	45	Quiet limits at protected location
R4	North of Rollins South at residential lot line along Arab Road	3,090	55	45	Quiet limits at protected location
R5	East of Rollins South and 500 feet from dwelling	2,870	55	45	Quiet limits at protected location

[A]See Figure 3, Vicinity Site Plan.

The Maine DEP regulation specifies sound level limits in terms of hourly A-weighted equivalent sound levels (L_{Aeq-Hr}). At protected locations where tonal or short duration repetitive sound levels are present from operation of the wind project, 5 dBA is added to these sounds for purposes of determining compliance with applicable sound level limits.

7.0 FUTURE SOUND LEVELS

7.1 Construction

Sound from construction activity is both temporary and variable. Many construction machines operate intermittently and equipment varies with each construction phase. A variety of construction equipment will be used to build the wind project including earth-moving equipment for land clearing, excavation, and site grading, and cranes to erect the wind turbines. Typical earth moving equipment and cranes generate sound levels of 75 to 88 dBA at a distance of 50 feet.

Sound levels from construction may be noticeable in the vicinity of the site, especially during blasting, excavation and grading. Local traffic during construction is expected to increase on some public roads along with associated sound levels from construction vehicles. Because of the temporary nature of construction, no adverse or long-term effects are anticipated.

The mobile nature of construction equipment and the manner in which construction work must be done makes complete control of construction sound infeasible. With the possible exception of nighttime blade lifts, construction activity will occur between the hours of 7 a.m. and 7 p.m. or daylight hours, and therefore is not subject to Maine DEP sound limits. Sound from nighttime crane lifts is not expected to exceed sound levels from routine operation.

Other measures to mitigate construction sound levels will include compliance with federal regulations limiting sound from trucks and portable compressors, and ensuring that equipment and sound muffling devices provided by the manufacturer (or equivalent) are kept in good working condition.

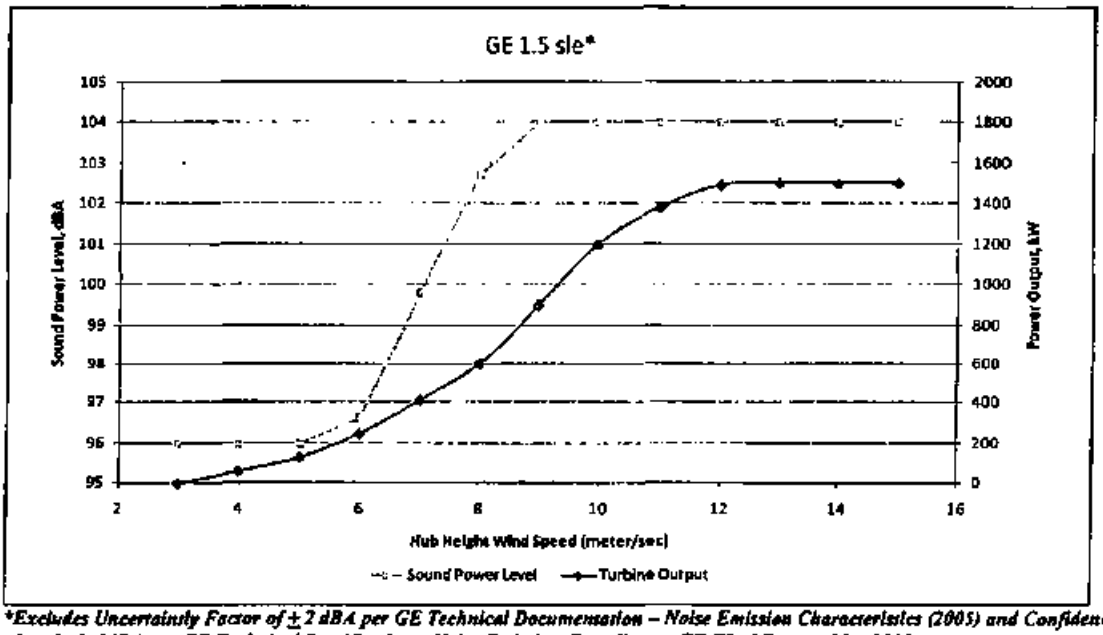
7.2 Proposed Operation

Operation of the proposed project will consist of 40 wind turbines operating up to 24 hours per day and seven days per week depending on weather conditions.

RSE developed a sound level prediction model to estimate sound levels from operation of the proposed Rollins Wind Project. The acoustic model was developed using the CADNA/A software program to map area terrain in three dimensions, locate proposed wind turbines and calculate outdoor sound propagation from the wind turbines. Area topography and wind turbine locations, for entry into CADNA, were provided to RSE by Stantec based on USGS topographic information and project design.

The wind project will be capable of operating any time of the day or night, including holidays and weekends. However, the wind turbines will only operate when the wind incident on the turbine hub is at or above the cut-in wind speed of 3 meters per second (6.7 mph). During periods of light or calm winds, sound level emissions from the wind project will be virtually non-existent. As the hub-height wind speed increases to 3 meters/sec, the turbines begin to rotate and will reach full sound power output at a wind speed of approximately 9 meters per second (20.1 mph) or 60% of rated power output. Full power generation from the wind turbines occurs when the hub-height wind speed is at or above 11.5 meters per second (25.7 mph). The turbines shutdown or "cut-out" when winds reach 25 meters per second (56 mph). Figure 4 presents a plot of the sound power level and power generation versus wind speed at the turbine hub for wind speeds ranging from 3 to 15 meters per second. Figure 4 indicates that full sound power occurs at or above 9 meters per second and the sound power level is approximately 4 dBA less at a wind speed of 7 meters per second.

Figure 4. Sound Power Level and Power Output of GE 1.5 sle Wind Turbine in Relation to Hub Wind Speed



**Excludes Uncertainty Factor of ± 2 dBA per GE Technical Documentation – Noise Emission Characteristics (2005) and Confidence Level of +2dBA per GE Technical Specification – Noise Emission Compliance, GE Wind Energy, May 2005.*

RSE calculated sound levels for simultaneous operation of the GE 1.5 sle wind turbines at all 41 prospective wind turbine locations at full sound power as defined by GE Energy. These moderate to full load conditions exist with wind speeds at or above 9 meters per second (20.1 miles per hour) at the turbine hub. The wind turbines were treated as point sources at the hub height of 80 meters (262 feet) above base/grade elevation using sound power levels from GE Energy (Technical Documentation Wind Turbine Generator System GE 1.5 sl/sle 50 & 60 Hz, Noise Emission Characteristics, 2005). Sound level estimates are based on the operating sound level at full sound power plus an uncertainty factor of

plus 2 dBA based on the GE specification and measurements by RSE of similar turbines during full operation. Sound levels from the wind turbines are not expected to increase at wind speeds greater than 9 meters/sec.

GE Energy determined turbine sound power levels in accordance with IEC 61400-11, Wind Turbine Generator Systems – Part 11: Acoustic Noise Measurement Techniques, 2002. Table 2 provides sound power levels by third octave and whole octave frequency as provided by GE Energy.

TABLE 2

WIND TURBINE SOUND POWER LEVELS
(Wind Speed > 9.0 m/s at turbine hub)

3rd Octave Band Center Frequency, Hz	Sound Power Level, dBA	Octave Band Center Frequency, Hz	Sound Power Level, dBA
50	76.2		
63	79.9	63	85.1
80	82.6		
100	84.8		
125	86.7	125	94.0
160	92.4		
200	90.7		
250	92	250	97.2
315	94		
400	94.3		
500	93.8	500	98.6
630	93.2		
800	94		
1000	92.8	1000	97.9
1250	92.3		
1600	91.5		
2000	89.6	2000	94.5
2500	87.1		
3150	84.8		
4000	82.2	4000	87.3
5000	78.6		
6300	75.9		
8000	71.3	8000	78.1
10000	70.8		
SUM	**104**	**SUM**	**104**

Source: Technical Documentation Wind Turbine Generator System GE 1.5sl/sle 50 & 60 Hz, Noise Emission Characteristics, 2005

Sound levels from wind turbine operation were calculated for six receiver points (R1 to R6) in the vicinity of the proposed wind project. Receiver points represent nearby protected locations where the most stringent MDEP nighttime limits apply. Sound levels at these receiver points have the greatest potential to exceed applicable Maine DEP limits. Dwellings and protected locations closer to the wind turbines than the receiver points (see Figures 3 and 6) have entered into a lease or agreement with Evergreen III so that Maine DEP sound level limits do not apply at these properties (ref. Maine DEP 375.10, Section C.5.s). Sound level attenuation from the wind turbines to the receiver points was calculated by the acoustic model in accordance with ISO 9613-2 "Attenuation of sound during propagation outdoors". ISO 9613-2 is an international standard commonly used for predicting sound levels from a noise source for moderate downwind condition in all directions.

For Rollins Wind the prediction model calculates attenuation due to distance, atmospheric absorption and intervening terrain. Conservative factors were applied for ground absorption assuming a mix of hard and soft ground. The surfaces of nearby lakes were specifically mapped and assigned no ground

absorption as appropriate for a hard, reflective surface. The model calculations exclude attenuation from foliage, which has the potential to reduce sound levels.

The stated accuracy of sound level attenuation calculations per ISO 9613-2 is plus or minus 3 dBA. To compensate for accuracy inherent in the calculation and measurement methods, 3 dBA has been added to the specified sound power levels. This is in addition to the plus 2 dBA uncertainty factor from the GE specification. Consequently, the overall adjustment to the rated sound power levels from GE specifications (Table 2) is plus 5 dBA yielding a sound power level of 109 dBA for model calculations. This adjustment reflects the range of sound levels for the proposed wind project based on RSE sound level measurements of similar operating wind turbines under a variety of weather and site conditions.

Using the model, sound level contours for operation of the proposed wind project were calculated for the entire study area. These results are presented in Figure 5 with the sound level contours of 55 dBA and 45 dBA are highlighted corresponding to Maine DEP quiet daytime and nighttime limits. Information for the project study area as presented on Figure 5 includes the turbine locations, USGS topographic contours, parcel mapping with hatching to shows parcels with easements or agreements, dwelling locations, public and private roads (red lines), and water bodies. A legend indicating the map symbols is provided on Figure 5.

From these contours, the expected sound level from full operation of the wind turbines can be determined for any point within the study area. Calculated sound levels at the receiver points are indicated on these figures. Table 3 compares estimated sound levels at the receiver points with Maine DEP nighttime sound level limits.

TABLE 3

ESTIMATED SOUND LEVELS FROM WIND TURBINE OPERATION

Receiver Position	Distance to Nearest Wind Turbine, Feet	Estimated Hourly Sound Level, $L_{Aeq\,Hr}$	Maine DEP Nighttime Limit, dBA
R1	4,660	38	45
R2	2,025	44	45
R3	2,140	43	45
R4	3,090	39	45
R5	2,870	42	45

The results from Table 3 indicate that sound levels at full operation of the wind project will be below the Maine DEP nighttime noise limits at the receiver points.

There are likely to be large fluctuations in wind speed from the hub height of the wind turbines at 262 feet to the regulated height of four to five feet above ground level. This can be a significant factor in sound emissions and outdoor propagation from both the wind project and ambient, non-turbine sound levels. The quietest periods of the day or night generally occur when the winds are light or calm. In addition, as the wind speed incident on a wind turbine drops below 9 meters/sec, sound levels from the turbine are reduced. Ambient, non-turbine sound levels, particularly from wind forces acting on trees and vegetation, may increase significantly when the turbine wind speed reaches 9 meters/sec or greater, as required for full sound power.

Variations in wind speed with elevation (wind gradient) may result in very different wind speeds near the ground than at turbine/rotor heights. In addition, there may be areas near the ground that are shielded from winds at certain directions. For example, with the general ridge line direction running north-south, lower land to the east would be protected from a westerly wind. Under these conditions, high winds may be present near the top and to the west of the wind turbines, but winds may be relatively

calm just east of the ridgeline. Consequently, the degree of masking by wind-induced ambient sound will fluctuate depending on the wind speed, direction, and location.

A regulated tonal sound occurs when the sound level in a one-third octave band exceeds the arithmetic average of the sound levels in the two adjacent one-third octave bands by a specified dB amount based on octave center frequencies (ref. Maine DEP 375.10.G.24). Turbine performance specifications indicate some potential for tonal sounds to occur in the 160 Hz third-octave band. Both the specifications and measurements of operating turbines by RSE indicate that the tonal threshold of 8 dBA is not likely to be exceeded. Therefore, the wind turbines are not expected to generate regulated tonal sounds.

Short duration repetitive (SDR) sounds are a sequence of sound events each clearly discernible that causes an increase of 6 dBA or more in the sound level observed before and after the event. SDR sound events are typically less than 10 seconds in duration and occur more than once within an hour. Measurements and observations by RSE during wind turbine operations indicate that sound levels can fluctuate over brief periods as noted by the passage of wind turbine blades. Observed measurements further indicate that these sound level fluctuations typically range from 2 to 4 dBA and thus do not result in the 6 dBA increase required to be SDR sounds as set forth in Maine DEP 375.10.

8.0 CONCLUSIONS AND RECOMMENDATIONS

The primary objectives of the Sound Level Assessment were to determine applicable sound level limits at protected locations and lot lines, estimate future sound levels from the proposed wind power project, and evaluate compliance with applicable sound level limits. Existing land uses were identified using a combination of site maps, aerial images, and field observations. Sound level estimates of future wind operation were calculated using a terrain-based acoustic model.

Sound level limits were applied per Maine DEP 375.10 based on land use mapping and landowner agreements. To be conservative with this sound level assessment, quiet limits of 45 dBA nighttime and 55 dBA daytime were utilized per Maine DEP regulations even though pre-development sound levels during conditions suitable for wind turbine operation can exceed Maine DEP thresholds for existing sound levels in a quiet area.

The results of this assessment indicate that sound levels from operation of the Rollins Wind Project will not exceed Maine DEP sound levels limits during construction or routine operation. Specifically, model estimates show that sound levels from the wind project will be below the Maine DEP nighttime limit of 45 dBA within 500 feet of a residence at nearby protected locations. Model estimates show that the property limit of 75 dBA will also be met.

Prior to operation of the wind project, RSE recommends monitoring pre-development ambient sound levels at points representing nearby protected locations and during periods representing wind turbine operating conditions. Ambient sound level measurements will provide useful data concerning the contribution of non-turbine sound levels during future operation of the wind project.

Once construction and startup of the wind project are complete, RSE recommends monitoring sound levels during routine wind project operations to verify compliance with relevant Maine DEP sound level limits.

FIGURE 1
RELATION BETWEEN SOUND PRESSURE IN PASCALS AND SOUND PRESSURE LEVEL IN DECIBELS

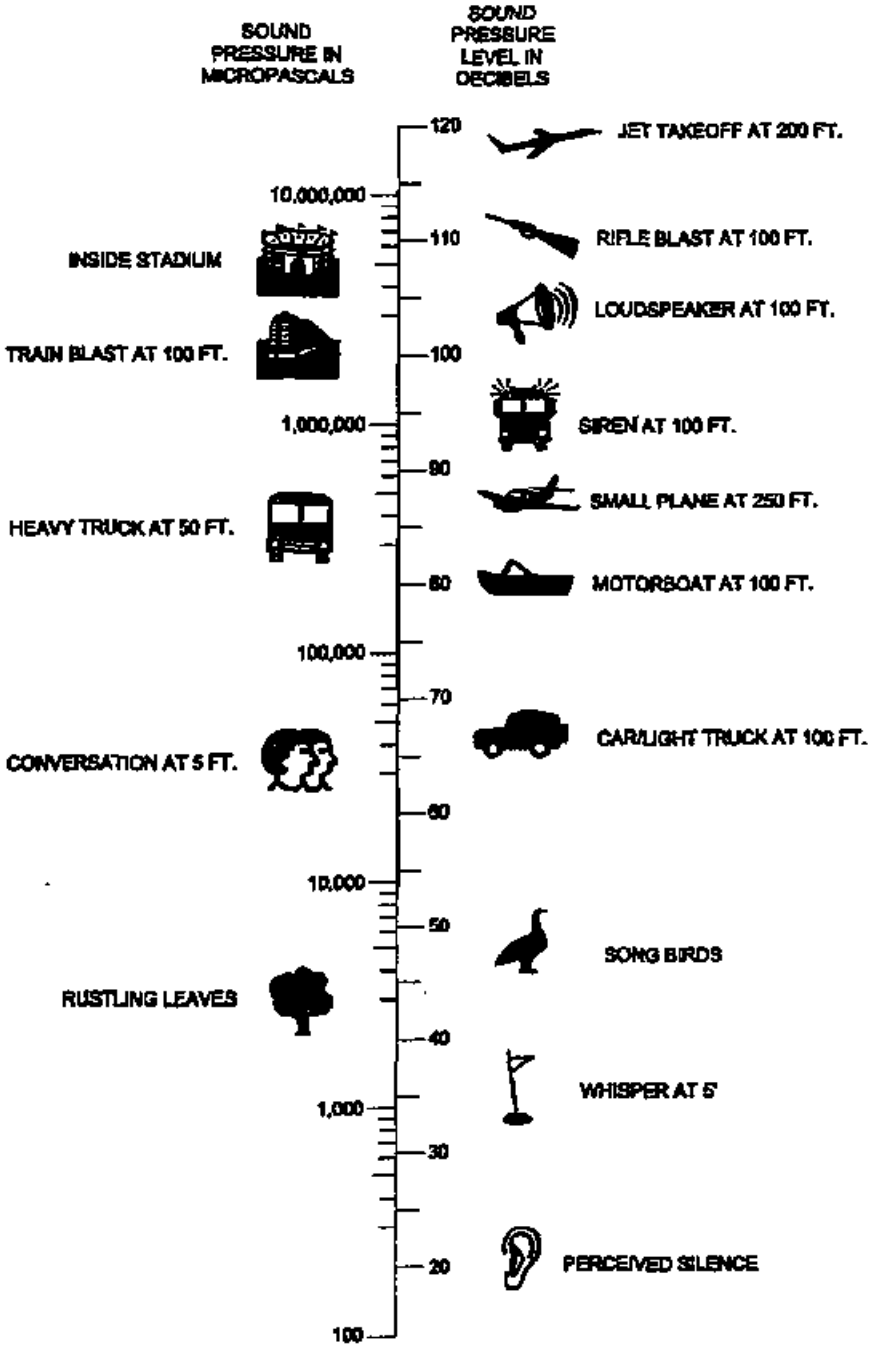
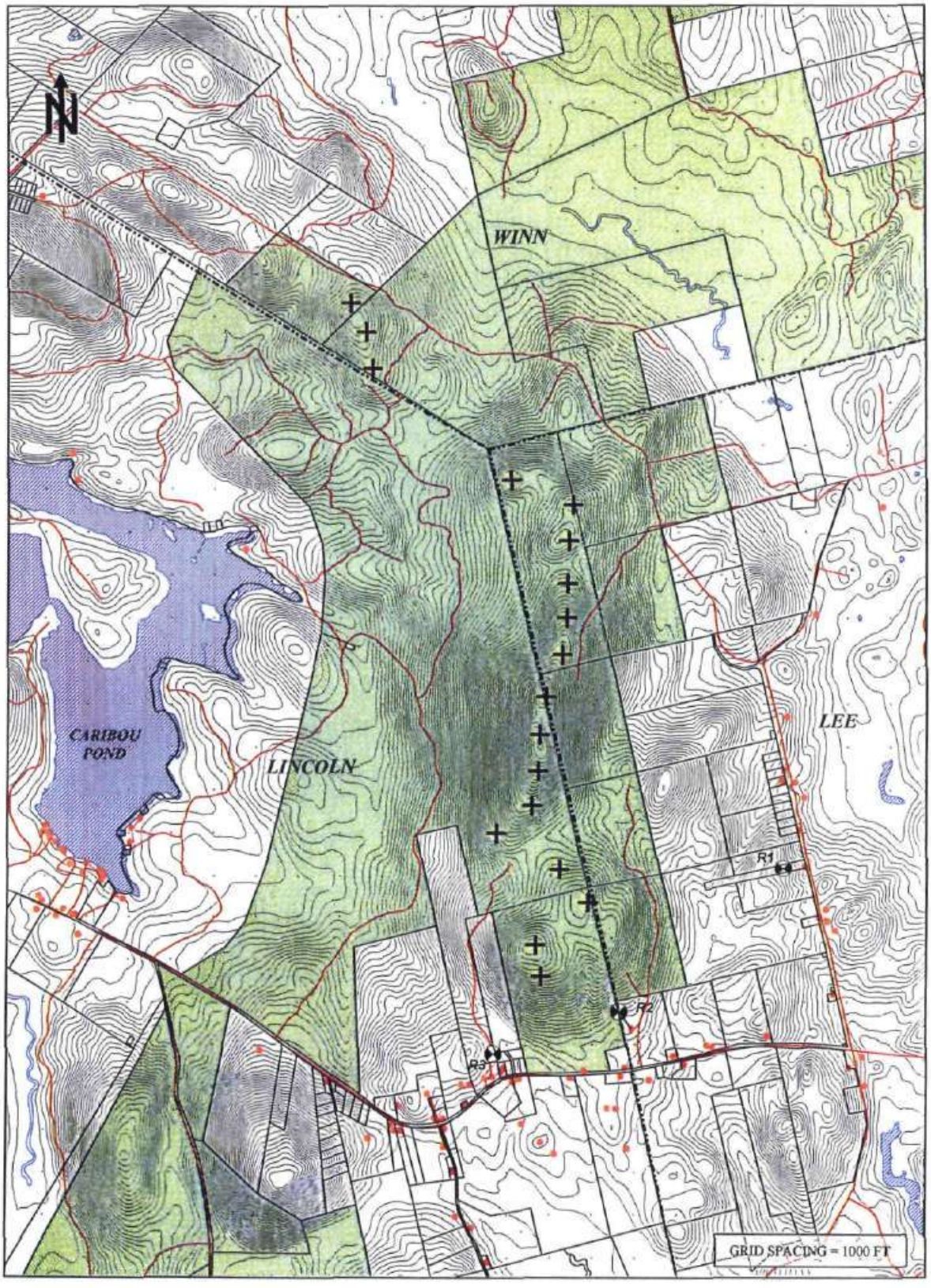


FIGURE 3. VICINITY SITE PLAN (1 OF 2)

ROLLINS NORTH



+ WIND TURBINE LOCATION ● DWELLING LOCATION PARCEL WITH LEASE OR AGREEMENT

FIGURE 3. VICINITY SITE PLAN (2 OF 2)

ROLLINS SOUTH

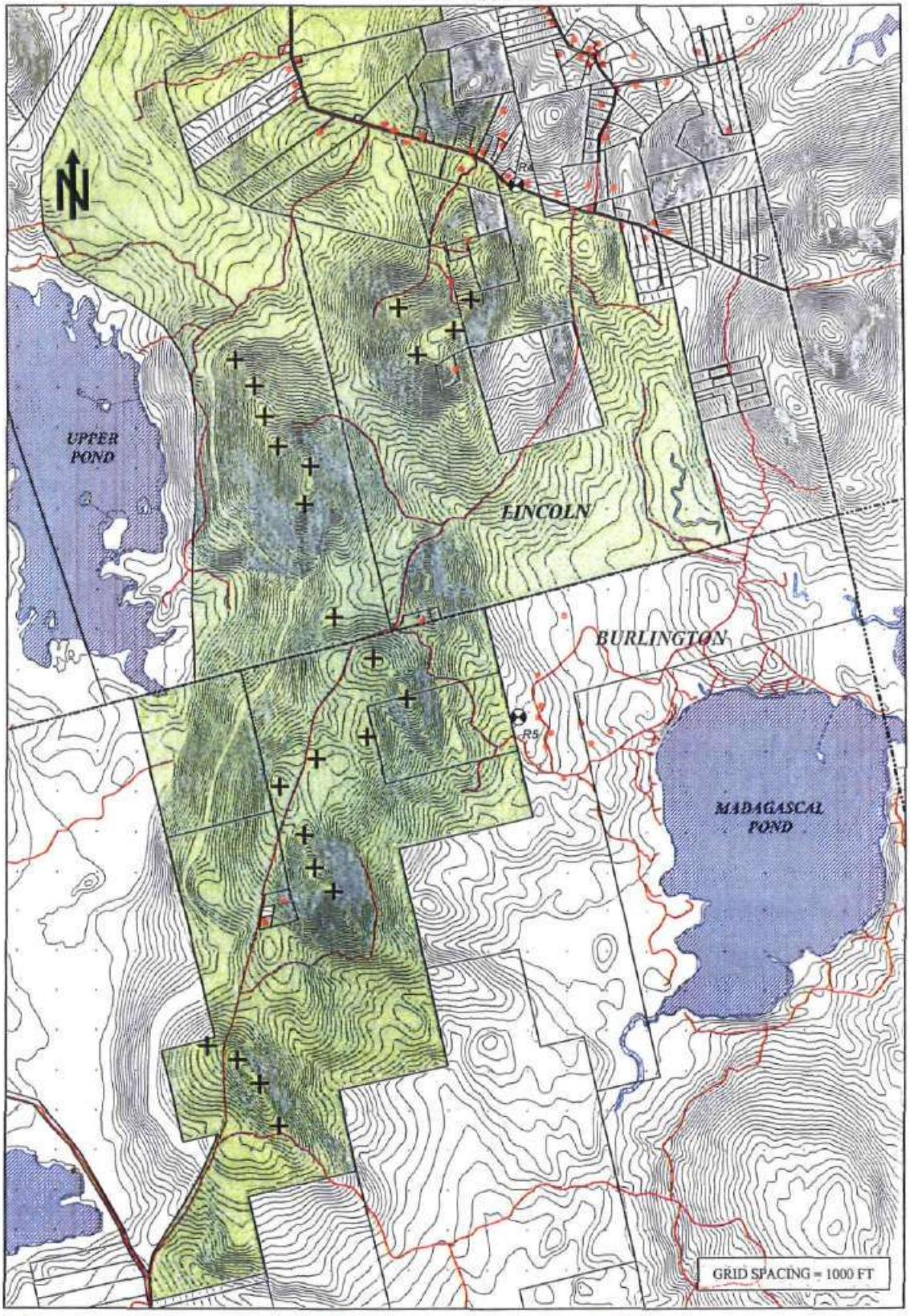


FIGURE 5. ESTIMATED SOUND LEVEL CONTOURS (1 OF 2)

ROLLINS NORTH

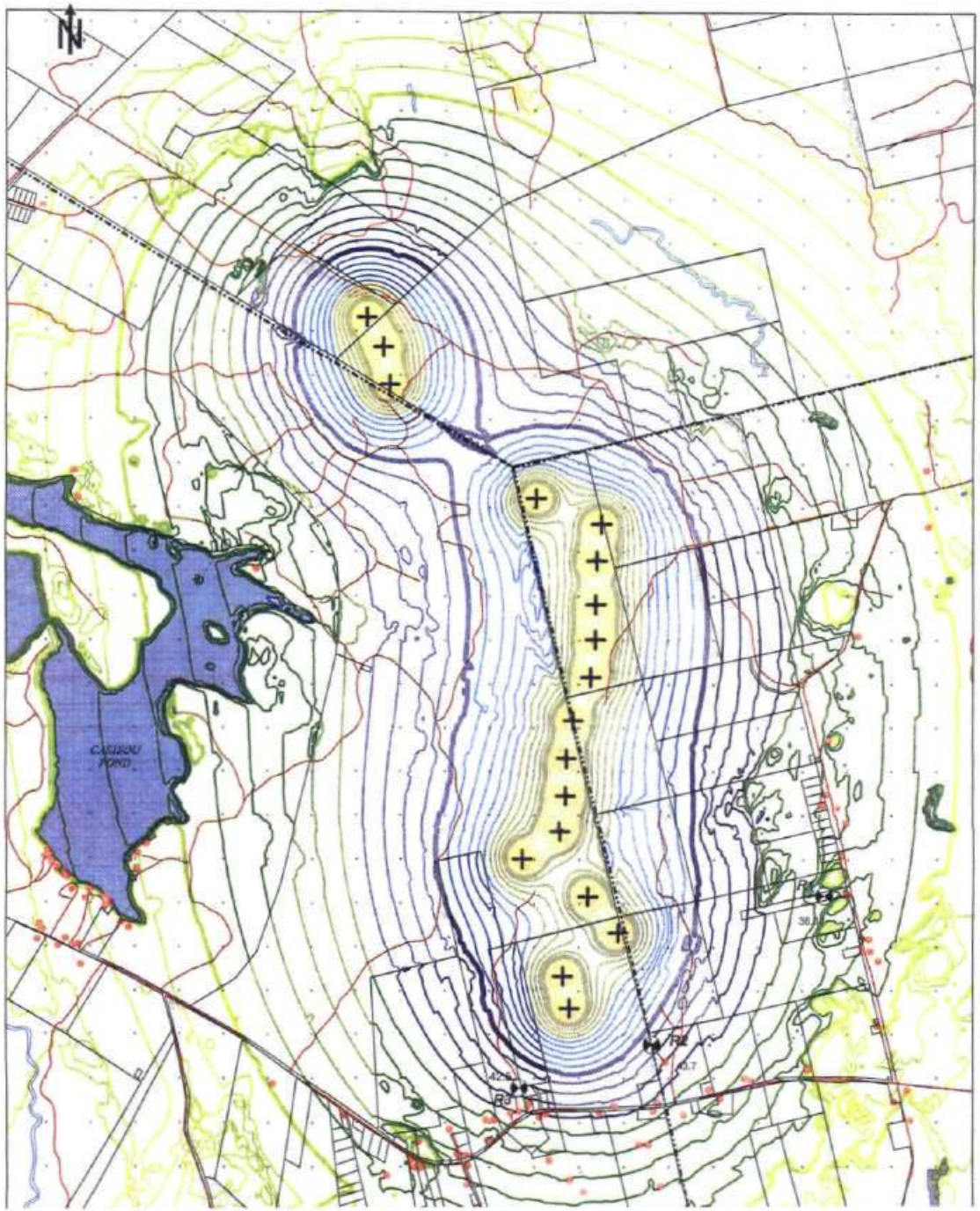
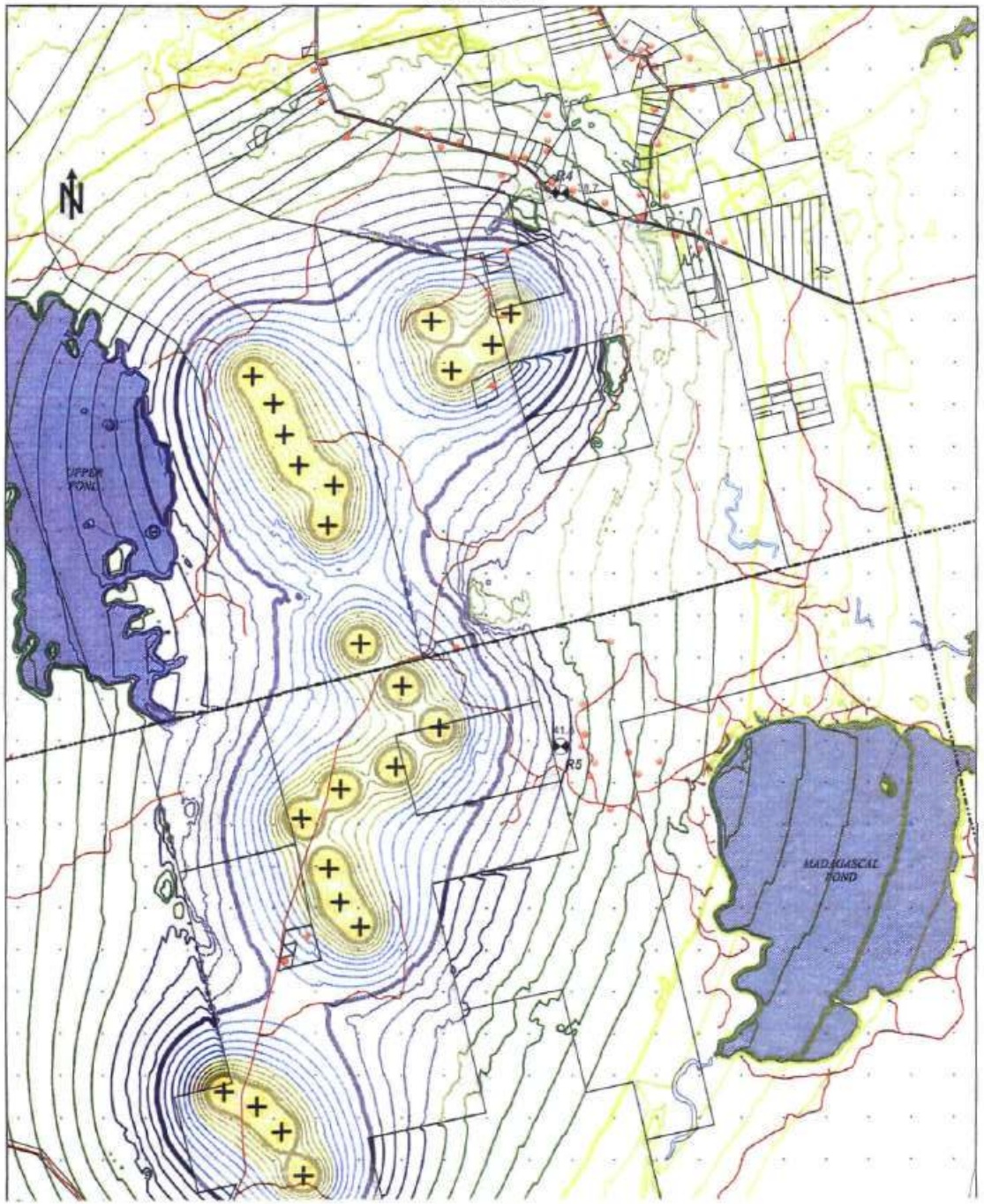
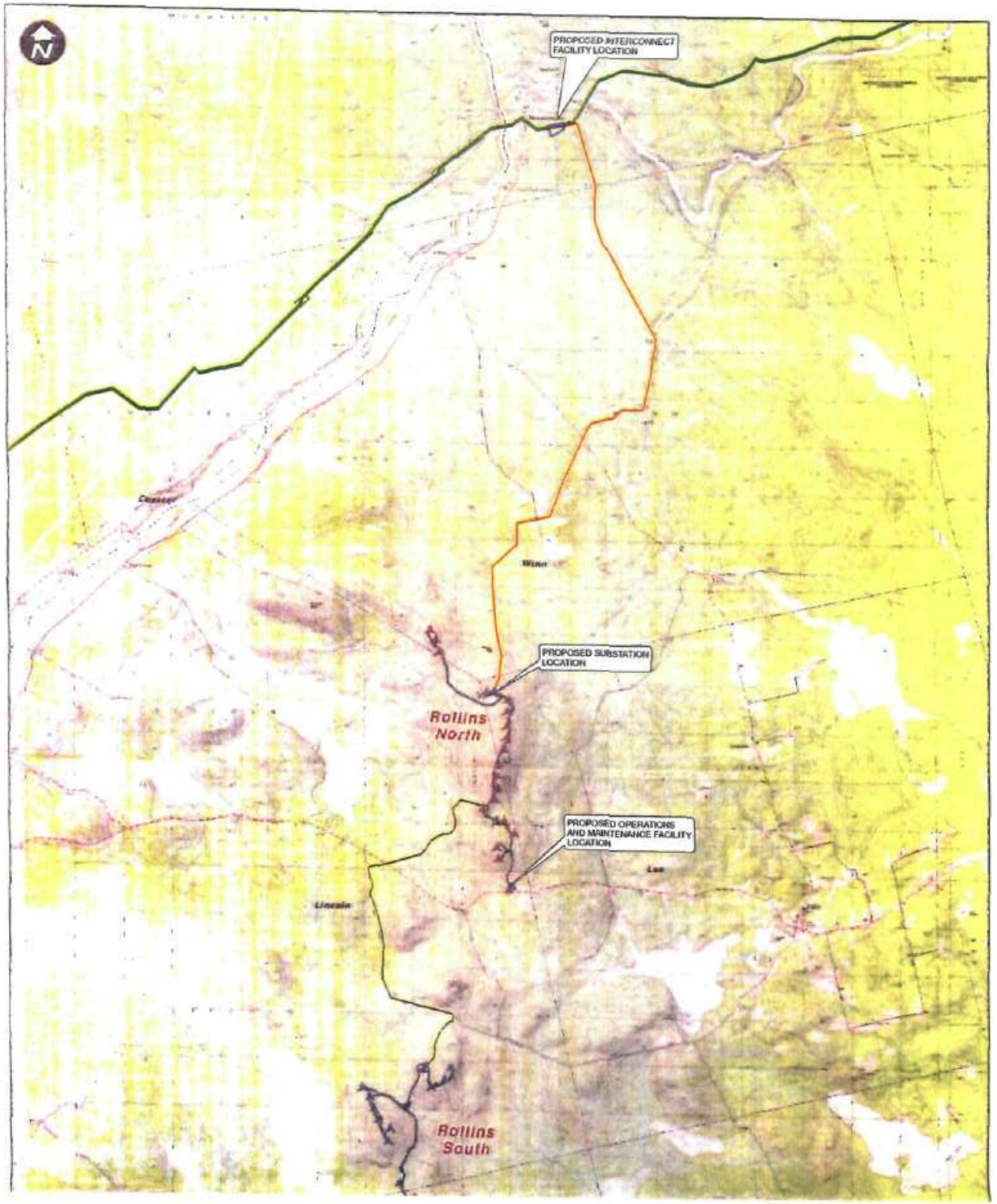


FIGURE 5. ESTIMATED SOUND LEVEL CONTOURS (2 OF 2)

ROLLINS SOUTH




PROPOSED INTERCONNECT FACILITY LOCATION
PROPOSED SUBSTATION LOCATION
Rollins North
PROPOSED OPERATIONS AND MAINTENANCE FACILITY LOCATION
Rollins South

Resource
Systems
Engineering

SUPPLEMENT

April 2, 2009
File 070827

REFERENCE: Sound Level Assessment
Rollins Wind Project
Penobscot County, Maine
October 30, 2008

The purpose of this Supplement is to provide information concerning specific dwellings as shown on an excerpt of Figure 5 of the referenced report. Table 4 provides the owner names and ownership status of the properties with dwellings now within the 45 dBA range of the Rollins project, based on the RSE sound level contour map of Rollins South, Figure 5, Sheet 2 of 2 dated October 30, 2008.

Table 4
Rollins South: Dwellings within 45 dBA iso-contour

Dwelling ID	Parcel Owner	Status	Reference
D1	Warren	Easement	Section 5
D2	Farling	Purchase	Section 2
D3	Wooten	Easement	Section 5
D4	Libby	Lease	Section 2
D5	Russell	Lease	Section 2
D6	Beitzel	Easement	Section 5

For dwelling locations, reference the attached Figure 5, Sheet 2 referencing the attached map:

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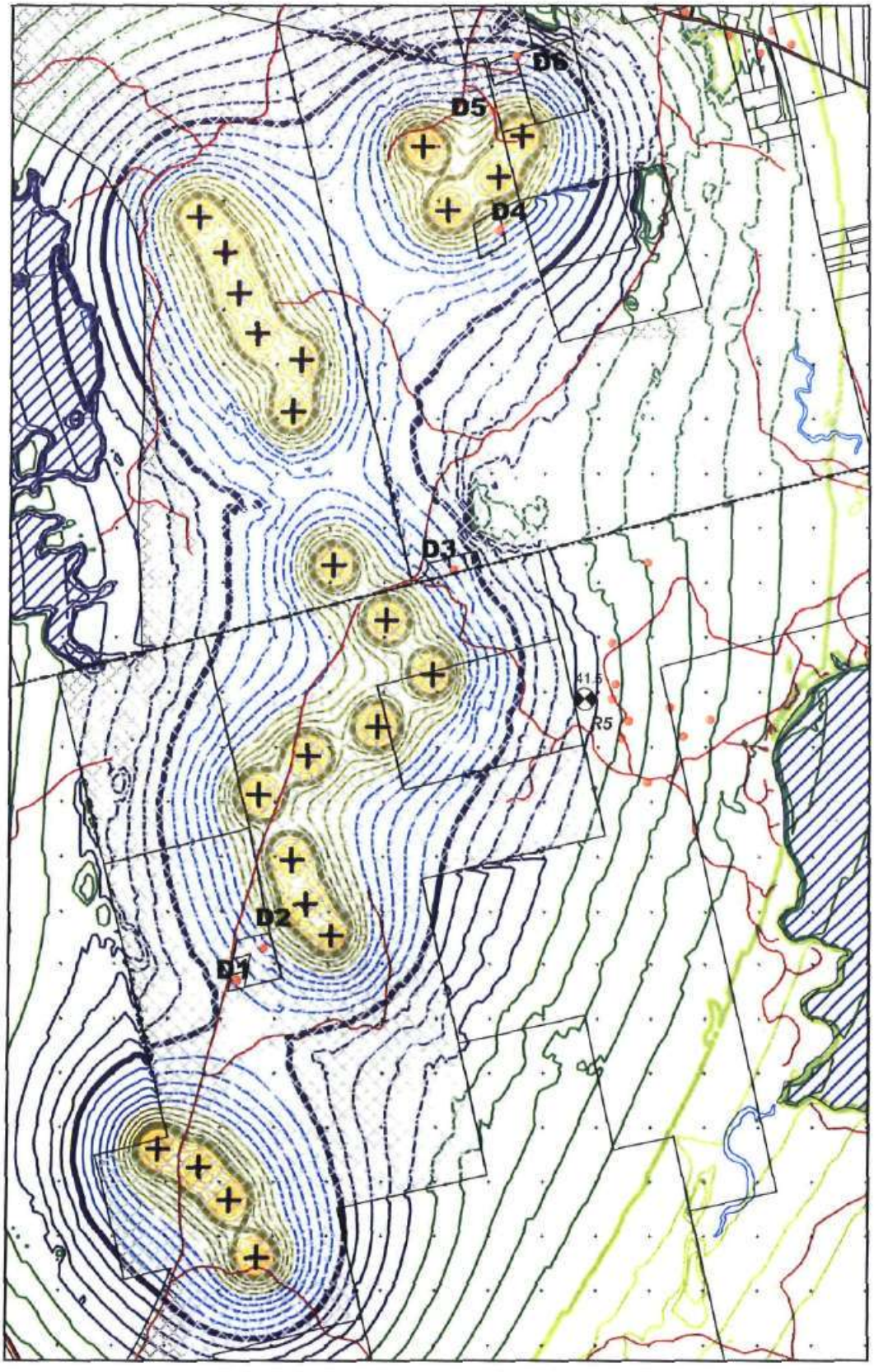
R. Scott Bodwell, P.E.
Sr. Project Engineer

Figure 5. Estimated Sound Level Contours (2of 2)
Rollins South
Excerpt



Resource Systems Engineering

Maddox, Becky

From: Barnes, Brooke [brooke.barnes@stantec.com]
Sent: Tuesday, March 10, 2009 10:10 AM
To: Maddox, Becky; Cassida, James
Cc: dcowan@upcwind.com; Ryan Chaytors; Browne, Juliet; Geoff West
Subject: Sources regarding Low Frequency and Infrasound from Large Utility Grade Wind Turbines
Attachments: Research into aerodynamic modulation of wind turbine noise.pdf; CANWEA%20Infrasound%20Study.pdf; AWS Truewind_LowFrequencyNoise.pdf

Hi Becky

Charlie Wallace of RSE did a literature review for technical papers on the issue of low frequency sound and infrasound related to wind turbines, and has provided the attached links. I thought they might be of interest to Warren Brown and/or Dora Mills in their review of the issues.

Also attached are a couple of other articles on the topic (I may have already sent these to you).

Brooke

From: Charles Wallace [mailto:RSE@gwi.net]
Sent: Friday, March 06, 2009 10:51 AM
To: 'Dave Cowan'; 'Matt Kearns'; 'Ryan Chaytors'; 'Alec Jarvis'; 'Timothy Clapp'; Barnes, Brooke
Subject: Sources regarding Low Frequency and Infrasound from Large Utility Grade Wind Turbines

All –

The subject of low frequency and infrasound from large, utility grade wind turbines has been getting a lot of attention in Maine and elsewhere. This topic has been the subject of two specialty European technical conferences (2005 & 2007) with a third scheduled for June 2009.

RSE has reviewed many sources in the course of our work and find a handful of technical documents that synthesize much of the other technical literature and present some empirical data as part of their presentation. Some just present an independent literature review of this issue. These documents are provided via their links. As a collection, these documents also contain a large number of additional references [many of them available at RSE] that allow a reader to chase related topics "to ground". Anecdotal papers and those that rely on secondary or tertiary sources that do not present empirical research or that do not have a clear scientifically peer reviewed history have not been included here. Also, papers that allege Wind Turbines cause certain diseases without quantitative, cause-and-effect, dose-response or unverified data are not included directly but are discussed in some of the cited sources.

Cited Resources:

- **Ohio Health Dept: *LITERATURE SEARCH ON THE POTENTIAL HEALTH IMPACTS ASSOCIATED WITH WIND-TO-ENERGY TURBINE OPERATIONS***
- **DELTA: Low Frequency Noise from Large Wind Turbines**
- **DELTA: The "GENLYD*" Noise Annoyance Model**
- **CanWEA Paper*: ADDRESSING CONCERNS WITH WIND TURBINES AND HUMAN***

HEALTH

- **Geoff Leventhall: *INFRASOUND FROM WIND TURBINES – FACT, FICTION OR DECEPTION***
- **National Research Council of The National Academies: Environmental Impacts of Wind-Energy Projects**
- Jakobsen J. and Andersen B. (1983): "Wind Noise. Measurements of Wind-Generated Noise from Vegetation and Microphone System", Danish Acoustical Institute Report no.108 [Out of print and available upon request from DELTA]

Regards,

Charlie -

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